Total Carbon Column Observing Network (TCCON) activities at Izaña, Tenerife (28°N, 17°W)

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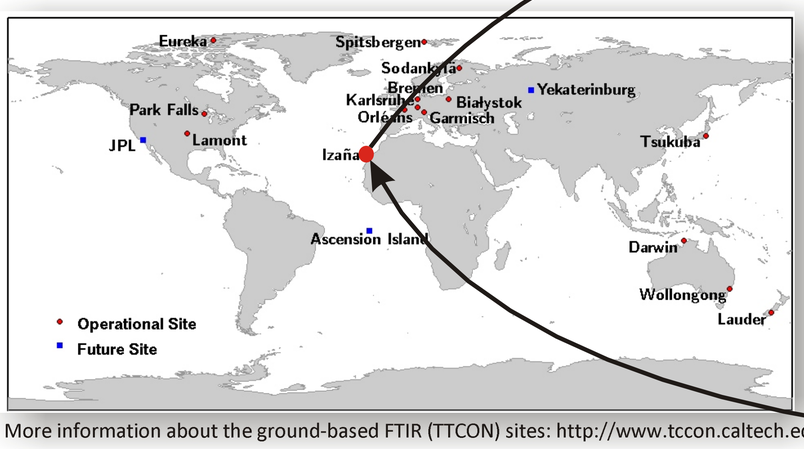
The Total Carbon Column Observing Network (TCCON) is a global network of ground-based Fourier Transform Spectrometers recording direct solar spectra in the near-infrared spectral region. With stringent requirements on the instrumentation, data processing and calibration, accurate and precise column-averaged abundance of CO_2, CH_4, N_2O, CO, HF, H_2O and HDO are retrieved. TCCON was initialized in 2004 and actually there are 19 sites affiliated around the world, being Izaña fully operational since May 2007.
We find a strong correlation between the retrieved O_2 column amounts and the dry pressure column obtained from a high precision manometer. This documents the good quality of the Izaña TCCON measurements. We show the retrieved annual cycles (from 05 May, 2009 to 08 June, 2010) of CO_2 and CH_4 and compare them to simultaneously performed in-situ measurements.

1. LOCATION

TCCON worldwide sites



More information about the ground-based FTIR (TTCON) sites: http://www.tccon.caltech.edu/

IZAÑA, TENERIFE, CANARY ISLAND, SPAIN, EUROPE, PLANET EARTH

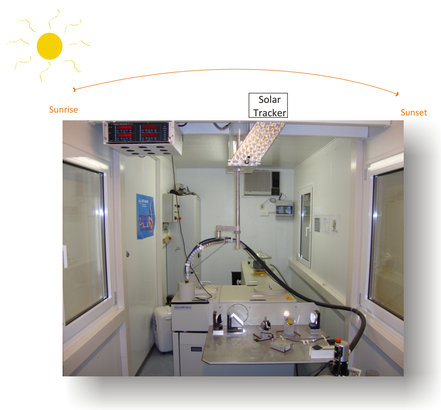
Izaña is a subtropical high mountain observatory located at 2370m. altitude, over a strong temperature inversion layer that works as a natural barrier for local pollution. It is well representative for atmospheric background conditions. Its latitudinal location complements the other mainly mid-latitudinal TCCON sites. Since many years Izaña has been a Global Atmospheric Watch (GAW) station and it has a comprehensive measurement program of a large variety of different atmospheric constituents.

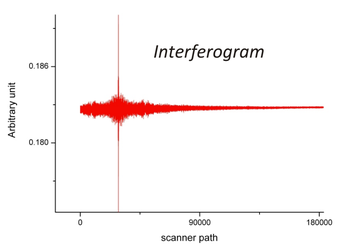
2. TCCON OBJETIVES

- *Carbon Cycle Study*: In order to better understand climate change, the greenhouse gas cycles have to be investigated: exchange of CO_2, CH_4, N_2O, etc., between the atmosphere, the biosphere, and the ocean. Column measurements sample a larger portion of the atmosphere, therefore they exhibit less variability than surface data, while retaining information about surface fluxes. Greenhouse gas column observations complement the surface in-situ data and provide additional constraints to the global carbon budget (Olsen and Randerson, 2004).
- *Satellite validation*: Global coverage is important for comprehensive carbon cycle research. Global monitoring of greenhouse gases requires space-based remote sensing. However, it is important to continuously document the quality of the space-based observations. In situ measurements from the existing surface network only inform about the planetary boundary layer. They cannot alone be used to validate space-borne measurements, which are also sensitive at higher altitudes. Only ground-based FTIR instruments can continuously provide precise total column amounts of greenhouse gases and they are indispensable for the validation of the different satellite sensors (e.g., SCIAMACHY, GOSAT, OCO).

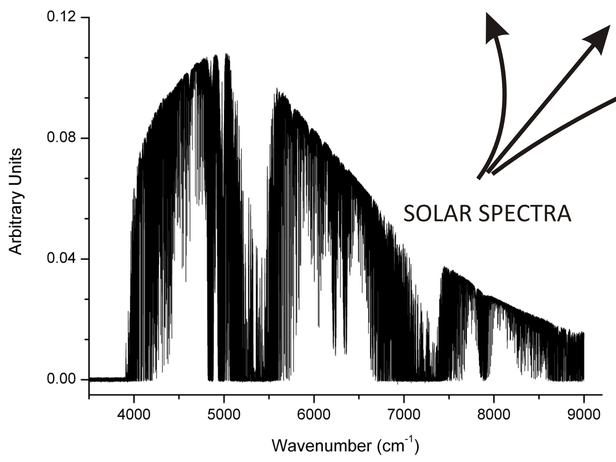
3. REMOTE SENSING TECHNIQUE

In the framework of TCCON high-quality, high-spectral resolution Fourier Transform InfraRed (FTIR) spectrometer are used in order to measure near infrared solar absorption spectra. The FTIR is an adapted Michelson interferometer. A Fourier transformation of the recorded interferogram yields the spectrum.

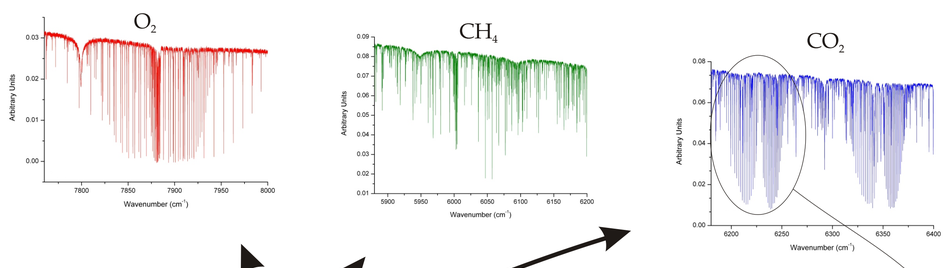




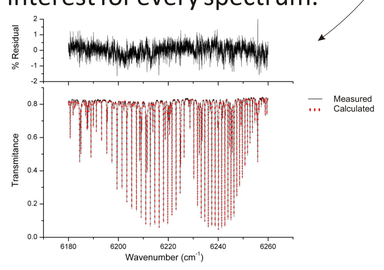
Fourier Transformation



SPECTRAL WINDOWS FOR COLUMN RETRIEVALS



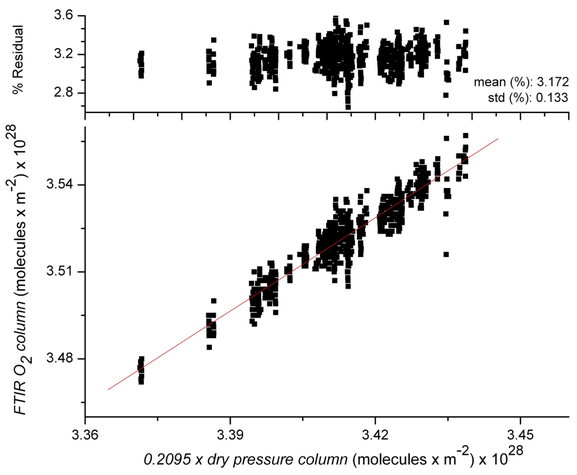
The measured spectra is processed with the nonlinear least squares fitting algorithm PROFFIT developed at the Karlsruhe Institute of Technology (F. Hase, et al., 2004), which computes profiles and total columns of the gases of interest for every spectrum.



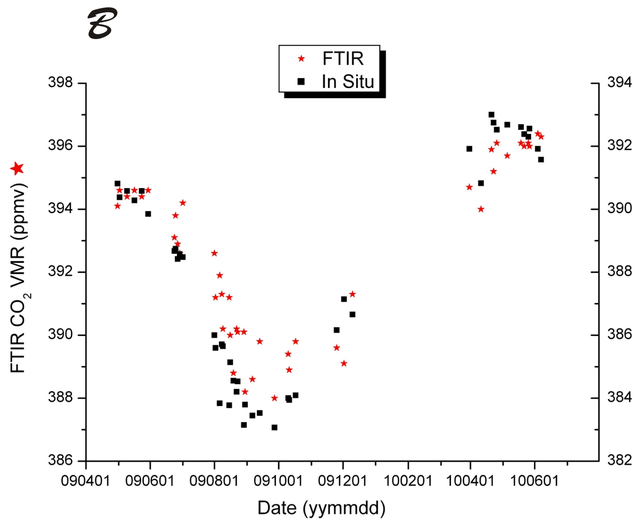
Bruker Spectrometer IFS 125HR housed in a container; Near InfraRed (NIR) spectral range 4000-9000 cm^{-1} at 0.02 cm^{-1} spectral resolution (45cm OPD), with CaF_2 beamsplitter and room-temperature InGaAs detector.

4. IZAÑA RESULTS

A



B



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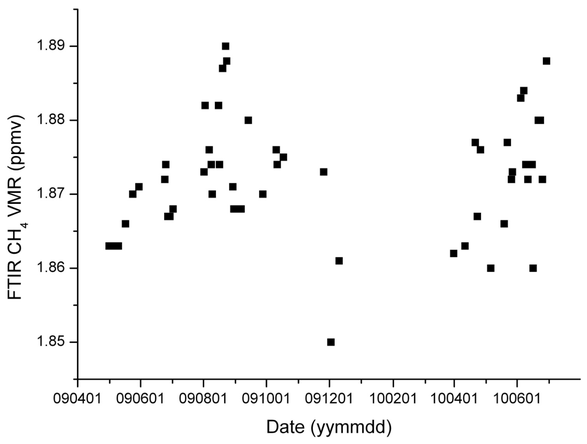


GRAPHS C shows the daily mean FTIR CH_4 measurements from 05 May, 2009 to 08 June, 2010.

NOTE: Due to operational problems there is a lack of FTIR measurements during the first three months of 2010.

GRAPH A shows the relationship between retrieved column O_2 and Dry Pressure Column (DPC), being DPC:

$$DPC = \frac{P_s}{m_{air} \cdot g} - column_{H_2O}$$

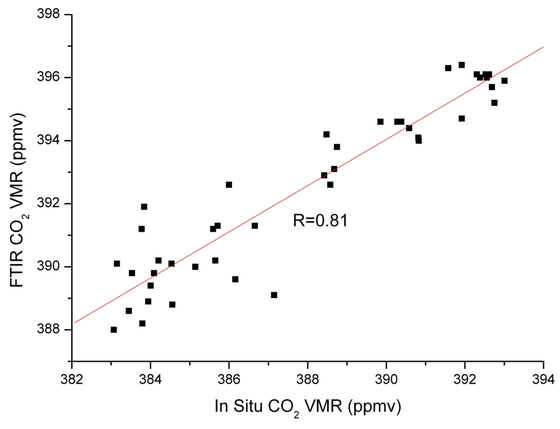
where,

P_s: pressure at surface level, obtained from a high precision manometer [(Setra System, Inc. Model 470 digital pressure transducer (±0.3hPa)]

m_{air}: molecular air mass

g: gravitational acceleration

D



GRAPHS B shows an annual cycle of daily mean FTIR and simultaneous in-situ CO_2 measurements from 05 May, 2009 to 08 June, 2010.

GRAPHS D shows the correlation between the retrieved CO_2 Volumen Mixing Ratio (VMR) and the in-situ VMR, measured simultaneously close by.

LITERATURE REFERENCES:
- Hase, F., et al., J. Q. S. R. T. 87, 25–52, 2004.
- Olsen, S.C. and Randerson, J.T., J.G.Res.,109, doi :10.1029/2003JD003968.

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